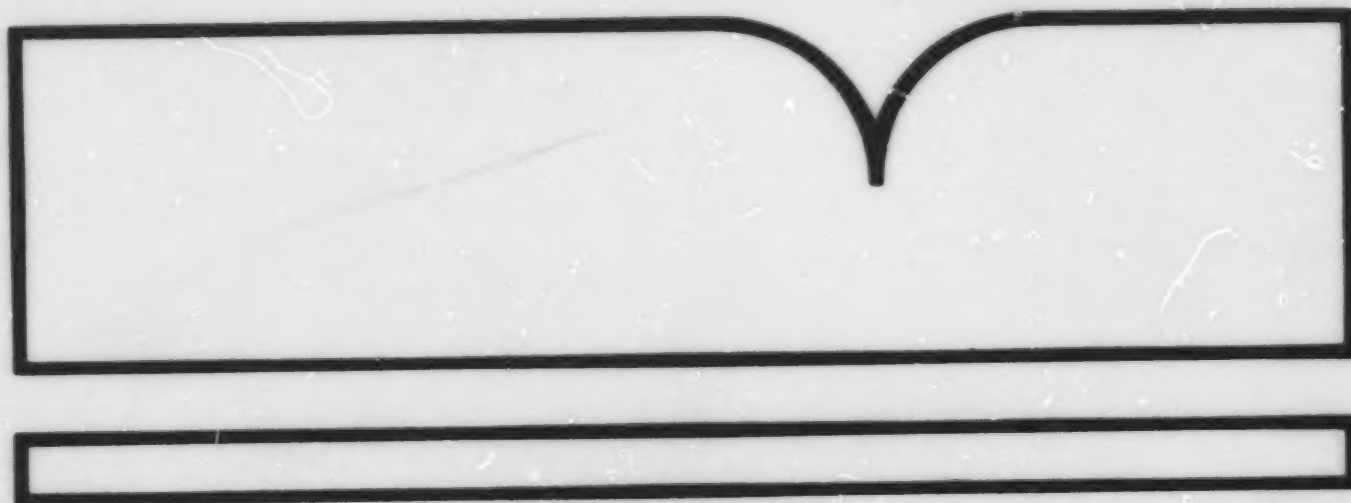


PB88-174594

**Health and Environmental Effects
Profile for 1,3-Dichloropropene**

**(U.S.) Environmental Protection Agency
Cincinnati, OH**

Jun 85



**U.S. Department of Commerce
National Technical Information Service**

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June 1985

PB88-174594

**HEALTH AND ENVIRONMENTAL EFFECTS PROFILE
FOR 1,3-DICHLOROPROPENE**

**ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE
OFFICE OF HEALTH AND ENVIRONMENTAL ASSESSMENT
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OH 45268**

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16. ABSTRACT The Health and Environmental Effects Profile for <u>1,3-dichloropropene</u> was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous waste constituents. Quantitative estimates have been presented provided sufficient data are available. <u>1,3-Dichloropropene</u> has been evaluated as a carcinogen. The human carcinogen potency factor (q_1^*) for <u>1,3-dichloropropene</u> is $1.74 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for <u>1,3-dichloropropene</u> is <u>100</u>.			
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DISCLAIMER

This document has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

PREFACE

Health and Environmental Effects Profiles (HEEPs) are prepared for the Office of Solid Waste and Emergency Response by the Office of Health and Environmental Assessment. The HEEP's are intended to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA), as well as to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files are evaluated as they pertain to potential human health, aquatic life and environmental effects of hazardous waste constituents. The literature searched and the dates of the searches are included in the section titled "Appendix: Literature Searched." The literature search material is current through November, 1984.

Quantitative estimates are presented provided sufficient data are available. For systemic toxicants, these include Acceptable Daily Intakes (ADIs) for chronic exposures. An ADI is defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect. In the case of suspected carcinogens, ADIs are not estimated in this document series. Instead, a carcinogenic potency factor of q_1^* (U.S. EPA, 1980) is provided. These potency estimates are derived for both oral and inhalation exposures where possible. In addition, unit risk estimates for air and drinking water are presented based on inhalation and oral data, respectively.

Reportable quantities (RQs) based on both chronic toxicity and carcinogenicity are derived. The RQ is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified under CERCLA. These two RQs (chronic toxicity and carcinogenicity) represent two of six scores developed (the remaining four reflect ignitability, reactivity, aquatic toxicity and acute mammalian toxicity).

The first draft of this document was prepared by Syracuse Research Corporation under EPA Contract No. 68-03-3228. The document was subsequently revised after reviews by staff within the Office of Health and Environmental Assessment: Carcinogen Assessment Group, Reproductive Effects Assessment Group, Exposure Assessment Group, and the Environmental Criteria and Assessment Office in Cincinnati.

The HEEP's will become part of the EPA RCRA and CERCLA dockets.

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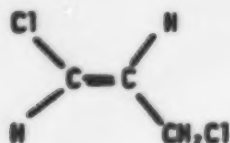
LIST OF ABBREVIATIONS

ALB	Albumen
ALP	Alkaline phosphalase
BCF	Bioconcentration factor
BOD	Biochemical oxygen demand
BUN	Blood urea nitrogen
bw	Body weight
CAS	Chemical Abstracts Service
CNS	Central nervous system
CS	Composite score
GC	Gas chromatography
GLU	Glutamic acid
GPT	Glutamic pyruvic transaminase
GSH	Reduced glutathione
HCT	Hematocrit
HGB	Hemoglobin
K _{oc}	Soil sorption coefficient
K _{ow}	Octanol/water partition coefficient
LC ₅₀	Concentration lethal to 50% of recipients
LD ₅₀	Median lethal dose
MED	Minimum effective dose
MS	Mass spectrometry
NADP	Nicotinamide adenine dinucleotide phosphate
NMR	Nuclear magnetic resonance
NOAEL	No-observed-adverse-effect level
NOEL	No-observed-effect level
NPS	Nonprotein sulphhydryl
ppb	Parts per billion
ppm	Parts per million
RBC	Red blood cell
RQ	Reportable quantity
RV _d	Dose-rating value
RV _e	Effect-rating value
STEL	Short-term exposure limit
TLV	Threshold limit value
WBC	White blood cell

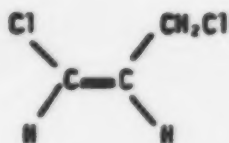
1. INTRODUCTION

1.1. STRUCTURE AND CAS NUMBER

The chemical commonly known as 1,3-dichloropropene is also known by the synonyms 1,3-dichloropropylene, 1,3-dichloro-1-propene (CAS usage), 3-chloroallyl chloride and 1,3-D. The structures for 1,3-dichloropropene are as follows:



(E) or trans-isomer



(Z) or cis-isomer

The molecular weight for 1,3-dichloropropene is 110.97 and the empirical formula is $C_3H_4Cl_2$.

The CAS Registry number for the commercial 1,3-dichloropropene product (which contains both cis- and trans-isomers) is 542-75-6 (TSCA-ITC, 1980). The CAS Registry numbers for the trans-isomer and cis-isomer are 10061-02-6 and 10061-01-5, respectively.

1.2. PHYSICAL AND CHEMICAL PROPERTIES

1,3-Dichloropropene is a colorless to light straw-colored liquid with an odor that can be sweet, sharp, penetrating or irritating (Verschueren, 1983). It exists in two isomeric forms, the trans- and cis-isomers. Selected physical properties are listed below:

Freezing point:	below -50°C (Martin and Worthing, 1977)
Boiling point:	104°C (cis) Verschueren, 1983) 112°C (trans) Verschueren, 1983)
Specific gravity, 20/4°C:	1.224 (trans) (Metcalf, 1981) 1.217 (cis) Martin and Worthing, 1977)

Refractive index, 20°C:	1.469 (trans) (Hawley, 1977) 1.475 (cis) (Hawley, 1977)
Vapor pressure, mmHg:	
at 25°C	43 (cis) (Dilling, 1977)
at 25°C	34 (trans) (Dilling, 1977)
at 20°C	25 (Callahan et al., 1979a)
at 20°C	27.9 (Hartley and Kidd, 1983)
Water solubility:	
at 20°C	2700 ppm (cis) (Dilling, 1977)
at 20°C	2800 ppm (trans) (Dilling, 1977)
at 20°C	0.1% (Hartley and Kidd, 1983)
Nonaqueous solubility:	soluble in methanol, acetone, benzene, CCl ₄ , toluene, octane (Hartley and Kidd, 1983; Hawley, 1977)
Flash point:	21°C (open-cup) (Hawley, 1977)
Log K _{OW} :	1.98 (calculated) (Callahan et al., 1979a)
Henry's Law constant:	0.095 (cis) (calculated) (Dilling, 1977) 0.072 (trans) (calculated) (Dilling, 1977)
Conversion factors:	
(air)	1 mg/m ³ = 0.22 ppm (Verschuieren, 1983) 1 ppm = 4.61 mg/m ³ (Verschuieren, 1983)

1.3. PRODUCTION DATA

1,3-Dichloropropene is manufactured commercially by Dow Chemical in Freeport, TX, and by Shell Chemical in Norco, LA, and Deer Park, TX (SRI, 1984; USITC, 1984). The production data available from the U.S. EPA TSCA Production File for 1977 are given in Table 1-1. More recent production figures were not available. Neither import nor export figures for this chemical were located in the available literature.

Shell Chemical manufactures 1,3-dichloropropene as a component of a soil fumigant with the trade name, D-D®. D-D is produced by the high temperature chlorination of propylene and contains ~50% 1,3-dichloropropene (both trans- and cis-isomers) and ~30% 1,2-dichloropropane, along with 3,3-dichloropropene, 2,3-dichloropropene and related C₃ chlorinated hydrocarbons (Hartley and Kidd, 1983; Martin and Worthing, 1977; Ouellette and King,

TABLE 1-1
1977 Production Data for 1,3-Dichloropropene*

Producer	Type	Production
Dow Chemical Freeport, TX	manufacturer	10-50 million pounds
Shell Chemical Norco, LA	manufacturer	1-10 million pounds
Columbia Organics Columbia, SC	manufacturer	<1000 pounds

*Source: U.S. EPA, 1977

1977). A similar mixture has been marketed by Dow Chemical as Vidden D® and Telone® (Ouellette and King, 1977). Dow Chemical also produces a product called Telone II® that contains 92% 1,3-dichloropropene, and 8% inert ingredients and is marketed as a soil fumigant (Chemical Week, 1976). Telone C® is a mixture of 85% 1,3-dichloropropene and 15% chloropicrin (Ouellette and King, 1977).

1.4. USE DATA

1,3-Dichloropropene and its formulations are used in soil fumigation (Hartley and Kidd, 1983; Martin and Worthing, 1977). The mixtures containing 1,3-dichloropropene are usually applied by injection into the soil or through tractor-drawn hollow tines, to a depth of 15-20 cm at 150-450 kg/ha depending on soil type and crop (Martin and Worthing, 1977); the soil surface is sealed by rolling. 1,3-Dichloropropene is effective in killing a variety of soil nematodes. In 1982 and 1976, 4.5 and 1.2 million pounds, respectively, of the commercial mixture containing 1,3-dichloropropene were used in the soil fumigation of tobacco fields (U.S. Department of Agriculture, 1983). In addition to tobacco, 1,3-dichloropropene is used in crop treatments for cotton, tomatoes, sugarbeets, broccoli, alfalfa, brussel sprouts and other crops (Maddy et al., 1982).

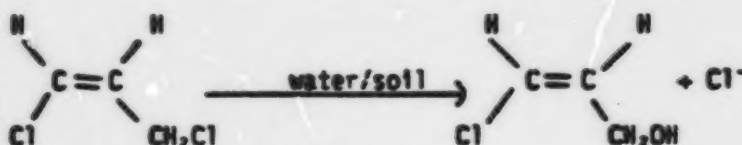
1,3-Dichloropropene can also be used in organic synthesis (Hawley, 1977), such as in the production of other pesticides.

2. ENVIRONMENTAL FATE AND TRANSPORT PROCESSES

The fate of 1,3-dichloropropene in the environment will depend upon its ability to undergo chemical, biological and photochemical reactions, and to transport or partition from one environmental matrix into another. The individual fate processes are discussed below with respect to water, air and soil.

2.1. WATER

2.1.1. Hydrolysis. Castro and Belser (1966) examined the hydrolysis of 1,3-dichloropropene (0.01 M) in water containing a phosphate buffer (0.1 M) at pH 6.9. Although temperature was not specified, it may be assumed that the experiment was conducted at ambient room temperatures; hydrolysis was determined by measuring the release rate of the chloride ion. From the data presented, the hydrolysis half-life for *cis*-1,3-dichloropropene appeared to be >20 days. Addition of soil to the aqueous solution increased the hydrolysis rate. The hydrolysis products of *cis*- and *trans*-1,3-dichloropropene were determined to be *cis*- and *trans*-3-chloroallyl alcohol, respectively. With respect to the *cis*-isomer, the hydrolysis reaction may be represented as follows:



Vernon (1954) determined the hydrolysis rate constant for *cis*- and *trans*-1,3-dichloropropene in a 50% water-ethanol solution at 44.6°C to be $1.7 \times 10^{-6} \text{ sec}^{-1}$. From this rate constant, TSCA-ITC (1980) extrapolated

the value to 100% water (at pH 7) using the Winstein and Grunwald (1948) method. The extrapolation yielded a hydrolysis rate constant at 44.6°C, in 100% water, of $1.1 \times 10^{-4} \text{ sec}^{-1}$; this corresponds to a half-life of 1.8 hours. Lyman et al. (1982) noted that a 25°C change in temperature typically caused a 10-fold change in the rate constant; this suggests that the extrapolated half-life at 20°C would be ~18 hours. Lyman et al. (1982), observed also, that the extrapolation of rate constants from both mixed solvents and temperatures combined is questionable for predicting environmental hydrolysis rates. Mabey et al. (1981) suggested that the hydrolysis of 1,3-dichloropropene at 25°C and pH 7 would be analogous to the similarly structured allyl chloride, which has a hydrolysis half-life of 69 days.

The available hydrolysis data discussed above suggest that hydrolysis will be significant in the aquatic environment.

2.1.2. Oxidation. Specific data regarding the aquatic oxidation of 1,3-dichloropropene were not located in the available literature cited in the Appendix. Mabey et al. (1981) reported that olefinic moieties may be environmentally susceptible to oxidation by singlet oxygen or alkyl peroxy radicals, which are generated by sunlight. They suggested that the minimum oxidation rate constant for oxidation with peroxy radicals is $4.4 \times 10^{-1} \text{ M}^{-1} \text{ hour}^{-1}$; assuming that natural water has a radical concentration of 10^{-9} M (Mabey et al., 1981), oxidation by peroxy radicals is not significant. Mabey et al. (1981) also suggested that the oxidation rate constant with singlet oxygen is $<10^{-1} \text{ M}^{-1} \text{ hour}^{-1}$. Natural waters in sunlight can have singlet oxygen concentrations of 10^{-12} M (Mabey et al., 1981); therefore, the half-life of 1,3-dichloropropene in the aquatic environment that is due to singlet oxygen is >289 days. Therefore, oxidation of

1,3-dichloropropene in the aquatic environment probably plays a minor role in the disappearance of the compound in comparison with hydrolysis and volatilization.

2.1.3. Photolysis. Pertinent data regarding the direct or photosensitized photolysis of 1,3-dichloropropene in water at environmental conditions were not located in the available literature cited in the Appendix.

2.1.4. Microbial Degradation. Tabak et al. (1981) examined the biodegradation of 1,3-dichloropropene and 113 other organic priority pollutants included in the U.S. EPA Consent Decree list to ascertain the extent of microbial decomposition. The biodegradability test used was a static-culture flask-screening procedure using BOD dilution water containing 5 mg yeast extract/l, 5 and 10 mg/l concentrations of the test compound, and a 7-day static incubation of 25°C in the dark, followed by three weekly subcultures and incorporating settled domestic wastewater as microbial inoculum. Volatilization was also measured. With respect to 1,3-dichloropropene, this test demonstrated significant biodegradation with a gradual adaptation of the microbiota. At the end of the 7-day static incubation period, 55 and 54% of the 5 and 10 mg/l concentrations, respectively, of the 1,3-dichloropropene were degraded. At the end of 28 days, 85 and 84%, respectively, were lost. The loss of 1,3-dichloropropene by volatilization, using this test procedure, was measured to be 7-19%.

Kobayashi and Rittmann (1982) reported that 1,3-dichloropropene is degraded by sewage sludge under aerobic conditions.

2.1.5. Transport. The transport of 1,3-dichloropropene in the aquatic environment will depend on the ability of the compound to volatilize, to adsorb to particulate organic matter and sediment, and to bioaccumulate in aquatic organisms.

2.1.5.1. VOLATILIZATION -- Dilling et al. (1975) and Dilling (1977) used laboratory experiments to measure the evaporation rate of a mixture of cis- and trans-1,3-dichloropropene from water. The 1,3-dichloropropene was dissolved in a beaker of water (at a concentration of ~1 ppm) at 25°C and stirred at 200 rpm in still air; average solution depth was 6.5 cm. The evaporative half-life was ~30 minutes; loss of 90% of the 1,3-dichloropropene required 98 minutes. While direct extrapolation of this test data to environmental conditions is not possible, it does demonstrate that volatilization will be a significant removal mechanism. Application of the U.S. EPA EXAMS computer simulation to the available data for 1,3-dichloropropene predicts environmental volatilization half-lives (at 20-25°C) ranging from 41 hours in a typical river to 12 days in an oligotrophic lake (Burns et al., 1981). The Henry's Law Constants (see Section 1.2.) also predict significant environmental volatilization.

2.1.5.2. ADSORPTION -- Experimental data regarding adsorption to particulate and sediment matter in the aquatic environment were not located in the available literature cited in the Appendix. Soil adsorption data presented in Section 2.3.4. are contradictory; however, in a dissolved water-phase, 1,3-dichloropropene does not appear to be adsorbed as readily as it is in the vapor-phase. In the aquatic environment, this suggests a reduced importance of adsorption to particulate matter. Sorption in the aquatic environment will retard the volatilization rate and make the compound more persistent.

2.1.5.3. BIOACCUMULATION -- Castro and Thomason (1973) examined the diffusion of 1,3-dichloropropene into and out of nematodes. They found that

the compound penetrated into the organisms rapidly, and they used the rate data to establish an equilibrium constant (i.e., BCF):

$$K_{eq} = K_{in}/K_{out} = 2.2 \times 10^{-2} \text{ sec}^{-1} / 1.6 \times 10^{-3} \text{ sec}^{-1} = 14$$

Kenaga (1980) used water solubility data and experimental soil sorption data to predict BCFs for 1,3-dichloropropene of 7 and 1, respectively; these are in good agreement with the value above. In addition, the calculated log K_{ow} of 1.98 (Callahan et al., 1979a) can be used to calculate a BCF of 19 from the equation derived by Veith et al. (1980) ($\log \text{BCF} = 0.76 \log K_{ow} - 0.23$); this is also in good agreement. These BCF values suggest that 1,3-dichloropropene will not be strongly bioaccumulated in aquatic organisms.

2.2. AIR

The atmospheric chemical removal processes include reaction of the target chemical with hydroxyl radicals, reactions with other radicals, reaction with ozone and photolytic transformations. Woodrow et al. (1983) reported that 1,3-dichloropropene undergoes vapor-phase photochemical reactions in a laboratory photoreactor that generates environmental levels of OH radical and ozone. Reaction or degradation rates were not determined; however, the presence of photochemically generated oxidants were required for transformation, suggesting that direct photolysis may not be significant. While rate constants for the reaction of 1,3-dichloropropene with OH radical or ozone are not available, these rate constant values are available for various chlorinated ethenes and 3-chloropropene (Lyman et al., 1982) that can be used to calculate half-lives at 27°C (Table 2-1). The data suggest that the reaction of 1,3-dichloropropene with atmospheric OH radical and ozone is likely to be significant and may be its major pathway for

TABLE 2-1

Rate Constants and Calculated Average Atmospheric
Half-Lives of Compounds Similar to 1,3-Dichloropropene^a

Compound	Reactant	Rate Constant at 27°C (cm ³ /mole-sec)	Calculated ^b Average Atmospheric Half-Life (days)
Chloroethene	•OH	3.9×10^{12}	2.1
Chloroethene	ozone	1.2×10^6	4.2
1,2-Dichloroethene	ozone	3.7×10^4	135.5
cis-	ozone	2.3×10^5	22.0
trans-	ozone		
Trichloroethene	•OH	1.2×10^{12}	6.7
3-Chloropropene	ozone	1.1×10^7	0.5
Propene	•OH	1.5×10^{13}	0.5
Propene	ozone	7.8×10^6	0.65

^aSource: Lyman et al., 1982

^bAssuming average atmospheric concentrations of •OH of 10^{-10} mol/cm³ and of ozone of 1.6×10^{-12} mol/cm³

removal from the air. In addition, the chemical degradation rates for the cis- and trans-isomers may not be identical, and one isomer may be somewhat more persistent than the other.

The physical removal processes in the air include dissolution, adsorption on aerosol particles and dry deposition. The method of Cupitt (1980) can be used to calculate an average atmospheric dissolution half-life, which is >400 years for 1,3-dichloropropene; any 1,3-dichloropropene removed by rainfall will be subject to relatively rapid re-volatilization. Adsorption and dry deposition are unlikely to be atmospherically important. Therefore, the physical removal processes are not found to be significant with respect to 1,3-dichloropropene.

2.3. SOIL

2.3.1. Chemical Hydrolysis. Castro and Belser (1966) studied the hydrolysis of 1,3-dichloropropene in water and in soil-water mixtures in laboratory tests. When 300 cc of soil were added to 1 L of a 0.01 M solution of cis-1,3-dichloropropene, the dichloropropene was found to hydrolyze 50% in 20 days. Similarly, the trans-isomer hydrolyzed to an extent of ~90% in 66 days. Increasing the amount of soil added to a ratio of 3:1 (soil:solution) increased the hydrolysis rate by approximately a factor of 2. These tests indicate the importance of 1,3-dichloropropene hydrolysis in moist soil; however, actual rates for ambient environmental conditions will be different because of variables such as temperature variations and effects of adsorption. Persistence data (Section 2.3.6.) (gathered under field conditions) suggest that hydrolysis in the natural environment does not occur as rapidly as suggested by the laboratory tests. The hydrolysis products of cis- and trans-1,3-dichloropropene are the corresponding cis- and trans-3-chloroallyl alcohols.

2.3.2. Microbial Degradation. Altman and Lawlor (1966) found that cultures of common soil bacteria are able to use 1,3-dichloropropene as a sole carbon source. Organisms able to use the compound included Rhizobium leguminosarum, Bacillus subtilis, Azotobacter vinelandii, Arthrobacter glabiformis, Pseudomonas fluorescens and two cornyebacteria. As noted in Section 2.1.4., static-culture flask-screening tests have demonstrated that 1,3-dichloropropene can be biodegraded significantly.

Belser and Castro (1971) examined the biodegradation of cis- and trans-3-chloroallyl alcohol, the hydrolysis products of 1,3-dichloropropene. A species of Pseudomonas isolated from soil was able to degrade these alcohols.

Tu (1973, 1978) examined the effects of various pesticides on soil microorganisms in a sandy loam soil; high levels of 1,3-dichloropropene did not adversely affect bacterial populations or activities to significant degrees. Van Faassen and Lebbink (1984) also reached this conclusion from field testing in the Netherlands.

The available data are not sufficient to predict the relative environmental significance of microbial degradation. No studies were available from the literature that examined 1,3-dichloropropene degradation in natural soil vs. sterilized soil. The available hydrolysis and persistence data seem to suggest that hydrolysis may be more important than biodegradation.

2.3.3. Photolysis. Pertinent data regarding the photolysis of 1,3-dichloropropene were not located in the available literature cited in the Appendix.

2.3.4. Adsorption-Leaching. As a soil fumigant, liquid 1,3-dichloropropene is usually injected 15-20 cm below the soil surface (Martin and Worthing, 1977). Four parameters of the soil that affect translocation of a

fumigant are its porosity-permeability, moisture content, organic carbon content and temperature. The predominant mode of movement of most fumigants through soil involves volatilization into soil air spaces, followed by gaseous diffusion (Munnecke and Van Gundy, 1979; Abdalla et al., 1974). Leistra (1970) studied the distribution of 1,3-dichloropropene in three soils over a temperature range of 2-20°C. Adsorption coefficients were found to be dependent upon organic content and temperature; adsorption increased significantly with increasing organic content and decreasing temperatures. Values of adsorption coefficients at 2°C were typically 2.5 to 3 times higher than at 20°C; the coefficient for trans-1,3-dichloropropene at 2°C in humous sand was 68, while it was 1250 in peat soil (much higher organic content). Also, adsorption of trans-1,3-dichloropropene was found to be significantly higher (roughly a factor of 2) than the cis-isomer. Leistra (1970) found that under normal soil moisture conditions, <1% of 1,3-dichloropropene is in the vapor phase, while 10-20% is dissolved in the water phase and 80-90% is adsorbed. Moderate amounts of water were also found to displace 1,3-dichloropropene from soil surfaces and allow partitioning between soil-water and soil-air to occur.

McKenry and Thomason (1971) noted that in very dry soil, 1,3-dichloropropene sorbs strongly to soil particles with very slow diffusion. Thomason and McKenry (1974) also reported that 1,3-dichloropropene applied as a soil fumigant is readily adsorbed.

Rexilius and Schmidt (1982) applied 1,3-dichloropropene to a podzolized sandy soil in a tree nursery, and, after irrigation, found it to be highly mobile in the soil. After 4 days, it was found 4 m deep in the soil and was later found in neighboring irrigation wells, demonstrating significant leaching. In contrast, Maddy et al. (1982) examined 54 water wells in

California located near fields fumigated with 1,3-dichloropropene and found no trace of the chemical in any well, suggesting its nonleachability or degradation before reaching the water table. Vanachter and Van Assche (1970) and Abdalla et al. (1974) reported that soil moisture inhibits the vertical spread of 1,3-dichloropropene.

Rao and Davidson (1982) reported the following experimentally-derived K_{oc} values for the vapor-solid adsorption: cis-1,3-dichloropropene = 798.1 and trans-1,3 dichloropropene = 1379.0. These values indicate moderate soil mobility. In contrast, Kenaga (1980) reported experimental K_{oc} values for the trans- and cis-isomers to be 75 and 23, respectively. These values indicate high soil mobility. Prediction methods based on water solubility (Kenaga, 1980) and molecular topology (Sabljic, 1984) predict high soil mobility.

2.3.5. Volatilization. According to McKenry and Thomason (1974), 10% of 1,3-dichloropropene applied at a rate of 234 L/ha (depth of 30.5 cm in warm, moist sandy loam) would be lost to the atmosphere. Under dry conditions, the compound is more strongly sorbed to soil, which would suggest a decrease in volatilization. Volatilization of fumigants to the ambient atmosphere, however, will have some environmental significance.

2.3.6. Persistence. Williams (1968) applied D-D mixture to muck soil (200 gallons/acre) and sandy loam (100 gallons/acre) in August during field studies, and then examined the soil 8 months later after a mild, wet winter. Residues of 1.8 and 4.8 ppm cis- and trans-1,3-dichloropropene, respectively, were found in the muck soil, while levels of 0.30 and 0.39 ppm, respectively, were found in the sandy loam; according to Leistra (1970), this corresponds to a half-life <70 days. Leistra (1970) found that the half-life in peat soil was also <70 days.

Rexilius and Schmidt (1982) applied 1,3-dichloropropene to a podzolized sandy soil in a tree nursery and found that it persisted up to the 91st day (last day of the soil test); it was also found 140 days after application in neighboring irrigation wells. Vanachter and Van Assche (1970) reported that high soil moisture enhances the persistence of 1,3-dichloropropene.

2.4. SUMMARY

1,3-Dichloropropene is not expected to persist for long periods of time in either water or air. In water, volatilization may be the primary removal mechanism, with predicted half-lives on the order of several days to several weeks depending on localized conditions. Water hydrolysis is also expected to be significant, with rates dependent on temperature; the hydrolysis products of cis- and trans-1,3-dichloropropene have been shown to be the corresponding cis- and trans-3-chloroallyl alcohols (Castro and Belser, 1966). While the biodegradability of 1,3-dichloropropene has been demonstrated, its importance in the general aquatic environment is not clear. 1,3-Dichloropropene is not expected to be strongly bioaccumulated.

In the atmosphere, reaction with hydroxyl radicals or ozone may be the predominant removal pathway for 1,3-dichloropropene, as suggested by atmospheric half-lives determined for similarly structured compounds. Physical removal from the air is not likely to be significant.

In the soil, chemical hydrolysis is expected to be a major removal mechanism with respect to 1,3-dichloropropene. The importance of microbial degradation is not clear, but it does not appear to be as significant as hydrolysis. Volatilization from soil may remove $\geq 10\%$ of 1,3 dichloropropene applied to the soil (McKenry and Thomason, 1974). Vapor-phase 1,3-dichloropropene is readily adsorbed by dry soil; soil adsorption is increased with increasing organic matter content and decreasing temperatures. Although the

soil adsorption data are contradictory, 1,3-dichloropropene is apparently lightly to moderately bound to soils. Persistence in the natural soil environment, which can have half-lives >70 days, is significantly longer than predicted by laboratory studies. Adsorption in natural soils may retard hydrolysis.

3. EXPOSURE

3.1. WATER

The U.S. EPA STORET Data Base contains data on environmental concentrations of 1,3-dichloropropene in water, sediment and fish tissue; the gross analysis of these data is presented in Table 3-1.

Dowty et al. (1975) reported the detection of 1,3-dichloropropene in drinking water, taken directly from the tap in New Orleans, LA. Concentrations were not quantified; however, the relative concentration in the tap water was 29% of the concentration detected in the water source (Mississippi River) before water treatment at the local treatment plant, as determined by GC data. Callahan et al. (1979b) detected trans-1,3-dichloropropene, at a concentration of 1.0 ppb, in 1 of 6 water samples taken at the influent to a water treatment facility in an unnamed midwestern city; the compound was not detected in the finished drinking water. The Ohio River Valley Water Sanitation Commission (1979), in cooperation with the U.S. EPA, sampled raw and finished waters from 11 water utilities in Ohio, Kentucky, Pennsylvania and West Virginia for the presence of organic pollutants. Trans-1,3-dichloropropene was detected only once and was of insufficient concentration (<0.1 ppb) for GC/MS confirmation; cis-1,3-dichloropropene was presumptively identified twice, but GC/MS confirmation was not possible.

Maddy et al. (1982) examined samples of water obtained from 54 supply wells in California for the presence of cis- and trans-1,3-dichloropropene and its degradation product, chloroallyl alcohol. The well locations were selected for their proximity to farm fields in which 1,3-dichloropropene was used as a soil fumigant. Neither 1,3-dichloropropene nor chloroallyl alcohol were detected in any of the wells.

TABLE 3-1
Gross Analysis of Concentrations of 1,3-Dichloropropene
in Water, Sediment and Fish Tissue

	Water	Sediment (dry weight)	Tissue (wet weight)
Number of observations	1675	341	146
Maximum concentration	320.0 µg/l	500.0 µg/kg	20.0 mg/kg
Minimum concentration	0.0 µg/l	0.0 µg/kg	0.0 mg/kg
Mean concentration	6.07 µg/l	5.44 µg/kg	0.19 mg/kg

3.2. FOOD

Pertinent data regarding the detection of 1,3-dichloropropene in ready-to-eat foods were not located in the available literature cited in the Appendix. The U.S. EPA STORET Data Base indicates that 1,3-dichloropropene has been detected in fish tissue.

3.3. INHALATION

Pellizzari et al. (1979) reported on the detection of 1,3-dichloropropene in the ambient air of Baton Rouge, LA; from 11 total samples examined, two samples were positive, with concentrations of a trace and 10 ng/m³. Two of 11 samples were also positive with respect to an unidentified isomer of dichloropropene at concentrations of 106 and 261 ng/m³. Samples of ambient air from Houston, TX, were found to contain trace to 1293 ng/m³ levels of an unidentified dichloropropene isomer.

3.4. DERMAL

Pertinent data regarding ambient monitoring of dermal exposure were not located in the available literature cited in the Appendix.

4. PHARMACOKINETICS

4.1. ABSORPTION

Hutson et al. (1971) treated Carworth Farm E rats by gavage with cis- or trans-1,3-dichloro(^{14}C)propene in arachis oil at doses of 2.53-2.70 mg/rat. After 24 hours, -80-84% of the administered radioactivity from either isomer was excreted in the urine or as $^{14}\text{CO}_2$, indicating that at least 80% of the dose was absorbed by the gastrointestinal tract. Similar results were obtained by Climle (1979) in rats and by Dietz et al. (1984a,b) (Sections 4.3. and 4.4.). Absorption through the respiratory route can be inferred from studies of rats, dogs, guinea pigs and rabbits (Torkelson and Oyen, 1977) (Chapter 5). Unpublished studies cited in Torkelson and Oyen (1977) indicated skin absorption in rabbits (Section 5.6.).

4.2. DISTRIBUTION

Dietz et al. (1984a), measured the NPS content of tissues and the covalent binding to macromolecules of the forestomach, glandular stomach, liver, kidney and urinary bladder of rats treated with 1,3-dichloropropene. Male F344 rats and male B6C3F1 mice were administered a single oral dose of ^{14}C -1,3-dichloropropene. For the NPS studies, doses were 0, 1, 5, 25, 50 or 100 mg/kg; for binding studies, doses were 0, 1, 50 or 100 mg/kg. Significant depletion of NPS levels occurred in the forestomach of rats and mice at dosages of ≥ 25 mg/kg, with a depletion range of 17-51% of control values. NPS levels in the glandular stomach and liver were also depleted in a dose-dependent manner but at a less severe level. Limited macromolecular binding was noted in the liver, kidneys and urinary bladder, and was greatest at doses that caused the most depletion of tissue NPS in the forestomach and glandular stomach.

4.3. METABOLISM

Hutson et al. (1971) fed 2.53-2.70 mg/rat of cis- or trans-1,3-dichloro(^{14}C)propene to rats and found differences in metabolism between the isomers (see Section 4.1.). In the first 24 hours, 80-90% of the radioactive dose was eliminated. Most of the radioactivity was excreted in urine, with 80.7% of the radioactivity from cis-1,3-dichloropropene and 56.5% of the radioactivity from trans-1,3-dichloropropene recovered from urine. The amount of $^{14}\text{CO}_2$ excreted was not the same for the two isomers; 3.9 and 23.6% of the dose from the ^{14}C -cis- and trans-isomers, respectively, were excreted as $^{14}\text{CO}_2$. A small amount of 1,3-dichloropropene was exhaled unchanged (1-4%).

Two female Wistar rats were given a single oral dose of cis-1,3-dichloro(^{14}C)propene of 20 mg/kg bw in corn oil (Climie, 1979). Eighty-two to 84% of the radioactivity appeared in the urine collected over 24 hours after treatment. Most of the urinary radioactivity (92%) was present as N-acetyl-S-[cis-3-chloroprop-2-enyl] cysteine (cis-dichloropropene mercapturic acid), as determined by comparative chromatography procedures.

When cis-dichloropropene (0.1 mM) was incubated at 37°C in vitro with rat liver 10,000 g supernatant (3.55 mg protein/ml) containing glutathione S-alkyl transferase and added glutathione (5 mM), no substrate remained after 10 minutes (Climie, 1979). When glutathione was omitted, 72% of the substrate was recovered. When rates of degradation of trans-isomer and cis-isomer were compared in vitro, cis-isomer was degraded 4-5 times faster than trans-isomer, with absolute rates of 4.9 and 1.0 nmol/minute/mg protein. In further experiments with [^{14}C]cis-dichloropropene under similar incubation conditions, a single metabolite was identified as S-[(cis)-3-chloroprop-2-enyl] glutathione.

According to Parker et al. (1982), lethal concentrations of 1,3-dichloropropene result in saturation of the glutathione detoxification pathways.

4.4. EXCRETION

In the previously described study by Hutson et al. (1971) (see Section 4.1.), the excretion by rats of radioactivity as a percentage of the administered oral dose of 2.53-2.70 mg/rat of cis- or trans-1,3-dichloro(^{14}C)-propene was determined for urine, feces and expired air. Measurements were taken at 24-hour intervals over a 4-day period. The animals were sacrificed after the fourth day following the administration of the labeled compounds and radioactivity remaining in the carcasses was measured. Excretion data are summarized in Tables 4-1 and 4-2. As seen from Table 4-1, 80% of administered radioactivity from cis-1,3-dichloropropene was eliminated during the first 24 hours, with a total elimination constant of 0.07 hour^{-1} . Greater than 50% of the dose of radioactivity from trans-1,3-dichloropropene was found in the urine after 24 hours, giving an elimination constant of 0.03 hour^{-1} .

When oral doses of ^{14}C -cis or trans-1,3-dichloropropene were given to male F344 rats (1 or 50 mg/kg) and to male B6C3F1 mice (1 or 100 mg/kg), urinary excretion was the major route of elimination after 48 hours (Dietz et al., 1984a,b). In rats, 51-61% of the dose was excreted in the urine; in mice, 63-79%. Approximately 18 and 6%, respectively, of the administered radioactivity was excreted in feces and as expired $^{14}\text{CO}_2$ in rats, and 15 and 14%, respectively, in mice. After 48 hours, only 2-6% of the original dose remained in the carcasses. Major metabolites were the mercapturic acid conjugate and the sulfoxide or sulfone derivative of N-acetyl-S-(3-chloroprop-2-enyl) cysteine.

TABLE 4-1
Rates of Excretion of Radioactivity After Oral
Administration of 1,3-Dichloropropene^a

Compound	Sex	Excretion of Radioactivity (% of administered dose) in 24-Hour Periods (hour after administration) ^b					Total (0- to 96-hour)
		0-24	24-48	48-72	72-96		
cis-1,3-Dichloropropene	M	81.3±2.76	1.9±0.21	0.6±0.14	0.3±0.06		84.1±2.94
	F	80.3±5.34	1.2±0.29	0.4±0.23	0.4±0.23		82.3±5.16
trans-1,3-Dichloropropene	M	54.6±1.92	0.6±0.06	0.3±0.04	0.1±0.02		55.6±1.90
	F	58.7±1.08	1.1±0.16	0.5±0.13	0.2±0.09		60.5±1.00
Feces							
cis-1,3-Dichloropropene	M	2.0±0.38	0.8±0.28	0.3±0.14	0.2±0.08		3.3±0.53
	F	1.4±0.43	0.2±0.04	0.1±0.03	0.1±0.05		1.8±0.42
trans-1,3-Dichloropropene	M	1.3±0.37	0.2±0.11	0.4±0.15	0.1±0.05		2.0±0.26
	F	1.9±0.24	0.2±0.10	0.2±0.10	0.1±0.02		2.4±0.26

^aSource: Hutson et al., 1971

^bThe values given are the means ± SEM for groups of six rats.

TABLE 4-2
Recoveries of Radioactivity from Rats in the 4 Days Following
Oral Administration of 1,3-Dichloropropene^a

Compound	Sex	Recovery of Radioactivity (% of Administered Dose) in 4 Days ^b						Exhaled Air		Total Radioactivity Recovered (% of Administered Dose)	
		Urine	Feces	Gut	Skin	Carcass	Carbon Dioxide ^c	Other Volatile Radioactivity ^c	Less Volatile Radioactivity	Including Volatile Radioactivity	
cis-1,3-Dichloropropene	M	84.0±2.94	3.3±0.53	0.1±0.01	0.5±0.09	0.8±0.06	5.3 (3)	NR	88.7±4.27	NR	
	F	82.3±5.18	1.9±0.42	0.1±0.02	0.5±0.07	0.5±0.02	2.4 (3)	1.4 (2)	85.5±4.27	89.0	
trans-1,3-Dichloropropene	M	55.6±1.90	2.1±0.28	0.2±0.10	0.6±0.07	1.1±0.11	22.7 (3)	NR	59.6±2.57	NR	
	F	60.4±1.00	2.3±0.26	0.1±0.01	0.5±0.13	0.9±0.11	24.4 (3)	3.5 (2)	64.2±1.01	92.1	

^aSource: Hutson et al., 1971

^bExcept where indicated otherwise, values given are the means ± SEM for groups of six rats.

^cValues given are means for the numbers of animals indicated in parentheses.

NR - Not reported

5. EFFECTS

5.1. CARCINOGENICITY

Although the final report of a carcinogenicity bioassay has not been published, a galley draft (NTP, 1984) was available. In this bioassay, Telone II®, a technical grade product containing 89% cis- and trans-1,3-dichloropropene, 2.5% 1,2-dichloropropane, 1.5% trichloropropene and 1.0% epichlorohydrin, was administered by gavage to rats and mice.

Groups of 52 male and 52 female F344 rats were given doses of 0, 25 or 50 mg/kg/day, 3 days/week for 104 weeks (NTP, 1984). Groups of 50 male and 50 female B6C3F1 mice were given doses of 0, 50 or 100 mg/kg, 3 times/week for 104 weeks.

In ancillary studies, groups of 28 male and 28 female rats and mice received Telone II® at the same doses used in the 2-year study. Interim kills of 5 animals/sex/group were performed at 9, 16, 21, 24 or 27 months.

No differences in survival were found among the groups of rats in the 2-year study with 35-42 rats/sex/group surviving until the end of the study. In mice, survival of the control males was significantly lower than in either the low- or high-dose group. Only 8/50 control male mice survived until the termination period, compared with 28/50 low-dose males and 31/50 high-dose males. Most of the deaths among male mice (25) occurred at weeks 48-51 and were attributed to myocarditis, which was not treatment-related. Survival of high-dose female mice was significantly less than the control, with 36/40 high-dose females surviving, compared with 46/50 female controls. Survival in low-dose females was 45/50.

Significantly increased incidences of neoplastic lesions were observed in the forestomach and liver of rats and in the forestomach, urinary bladder and lungs of mice. Tumor incidences and the results of Fishers Exact Test

(indicated beside the tumor incidence for treated animals) and for the Cochran-Armitage Test for dose-related trend (indicated beside the control incidence) are presented in Table 5-1. Although the early deaths of control male mice confounded the results, a carcinogenic effect of Telone II® was suggested by the tumor incidences of transitional cell carcinoma of the urinary bladder, alveolar/bronchiolar neoplasms and squamous cell papillomas of the forestomach in male mice.

Results of the ancillary studies indicated that the development of forestomach lesions was time-dependent. Pooling of the tumor incidences from the ancillary studies and the 2-year study (not shown in Table 5-1) enhanced the statistical significance.

It was noted that the Telone II® used in the bioassay contained 1.0% epichlorohydrin, a known carcinogen, which may have influenced the development of forestomach lesions.

A group of 30 female Ha:ICR mice was given weekly subcutaneous injections of cis-1,3-dichloropropene in trioctanoïn at a dose of 3 mg/mouse/week (Van Duuren et al., 1979). After 538 days, six mice had local sarcomas (6/30; $p < 0.0005$) upon examination of sections of the livers and the injection sites. All sarcomas were fibrosarcomas and no distant tumors were observed. No tumors developed in untreated and vehicle-treated controls.

Van Duuren et al. (1979) also studied cis-1,3-dichloropropene as a tumor-initiator and as a whole carcinogen when applied to the skin of mice. A group of 30 female HA:ICR mice received a single dermal application of 122 mg 1,3-dichloropropene in 0.2 ml acetone followed by phorbol myristate acetate in acetone at 5 µg, 3 times/week for 428-576 days. Controls consisted of 100 untreated mice, 90 mice treated with 0.0025 mg/application and 120 mice treated with 0.0050 mg/application of the tumor promoter. No

TABLE 5-1

Chronic Oral Exposure to Telone II^{a,b,c}
(2-year duration)

Species/Strain	Sex	Dose (mg/kg/day)	Target Organ	Tumor Type	Tumor Incidence (p value)
Rat/F344	M (52)	0	forestomach	squamous-cell papilloma	1/52
		25			1/52
		50			9/52
Rat/F344	M (52)	0	forestomach	squamous-cell carcinoma	0/52
		25			0/52 ^f
		50			4/52
Rat/F344	F (52)	0	liver	neoplastic nodule or carcinoma	0.015 ^d
		25			0.059 ^e
		50			0.015 ^d
Rat/F344	M (52)	0	forestomach	squamous cell papilloma or carcinoma	<0.001 ^d
		25			1/52
		50			13/52
Rat/F344	M (52)	0	liver	neoplastic nodules	0.030 ^d
		25			6/52
		50			7/52
Rat/F344	F (52)	0	forestomach	squamous-cell papilloma	0.082 ^d
		25			2/52
		50			3/52
Mice/B6C3F1	F (50)	0	forestomach	squamous-cell papilloma or carcinoma	0.026 ^d
		50			1/50
		100			4/50

TABLE 5-1 (cont.)

Species/Strain	Sex	Dose (mg/kg/day)	Target Organ	Tumor Type	Tumor Incidence (p value)
Mice/B6C3F1	F (50)	0 50 100	urinary bladder	transitional cell carcinoma	0/50 8/50 21/48 <0.001 ^d 0.003 ^e <0.001 ^e
Mice/B6C3F1	F (50)	0 50 100	lung	alveolar/ bronchiolar adenoma	0/50 3/50 8/50 0.002 ^d 0.121 ^e 0.003 ^e
Mice/B6C3F1	M (50)	0 50 100	lung	alveolar/ bronchiolar adenoma or carcinoma	2/50 4/50 8/50 0.029 ^d 0.339 ^e 0.046 ^e

QUALITY OF EVIDENCE

Strengths of Study: Two-year study, sufficient number of animals, both sexes, two dose levels, two species were used, ancillary studies were included (see text)

Weakness of Study: Male mouse vehicle control, had many early deaths from myocarditis

Overall Adequacy: Adequate

^aSource: NTP, 1984

^bCorn oil vehicle in all studies

^cPurity of Compound: 89% cis- and trans-isomers of 1,3-dichloropropene with 1.0% epichlorohydrin

^dCochran-Armitage Trend Test

^eFischer Exact test

^fNo p value is presented because no tumors were observed in the 25 mg/kg and vehicle control groups.

significant differences were observed between the dichloropropene initiated mice and those treated with the promoter alone with respect to local or distant tumors. When 1,3-dichloropropene was tested as a whole carcinogen, three papillomas developed in 3/30 female mice treated with 122 mg/application, 3 days/week for up to 589 days. Two of the mice had carcinomas. Although no local tumors were observed in mice treated at 41 mg/application or in acetone-treated or nontreated controls, the incidence in high dose mice was not significantly different. The number of mice with distant tumors was also not different from controls.

5.2. MUTAGENICITY

Studies on the mutagenicity of 1,3-dichloropropene are summarized in Table 5-2. 1,3-Dichloropropene was positive for reverse mutation in Salmonella typhimurium strains TA100 and TA1535 both with and without metabolic activation (NTP, 1984; Stolzenberg and Hine, 1980; Haworth et al., 1983). In S. typhimurium strain TA98, a positive response was obtained without metabolic activation (NTP, 1984; Haworth et al., 1983; Vithayathil et al., 1983). Although Talcott and King (1984) demonstrated that the mutagenicity to strain TA100 of mixtures of cis- and trans-1,3-dichloropropene, obtained from various sources, was abolished following removal of polar impurities, Creedy et al. (1984), Neudecker et al. (1977) and DeLorenzo et al. (1977) found that both the cis-isomer and the trans-isomer (both relatively pure) were mutagenic in S. typhimurium strains TA100, TA1538, TA1537, TA1535 and TA1978. Creedy et al. (1984) also demonstrated that if glutathione was added to the assay system, the mutagenicity of either isomer was reduced.

1,3-Dichloropropene was positive for sex-linked recessive lethal mutations, but negative for reciprocal translocations in Drosophila melanogaster (NTP, 1984).

TABLE 5-2
Mutagenicity of 1,3-Dichloropropene

Assay	Indicator Organism	Compound and/or Purity	Application	Concentration or Dose	Activating System	Response	Comment	Reference
Reverse mutation	<u>Salmonella typhimurium</u> TA100, TA1535, TA1537, TA98	1,3-dichloropropene (95.6%)	plate incorporation	0-3333 μ g/plate	$\pm$ S-9	+/+ +/+ -/- -/-	The chemical was tested in the presence of S-9 prepared from rat and hamster microsomes. The source of S-9 made no difference in the response. Where a positive response was obtained, the chemical was mutagenic at <333 μ g/plate; at >333 μ g/plate the chemical was cytotoxic.	KTP, 1984; Hamerlinck et al., 1983
Reverse mutation	<u>S. typhimurium</u> TA98	1,3-dichloropropene purity 98	liquid incubation	100 μ g/plate	none	+	MC	Vithayathil et al., 1983
Reverse mutation	<u>S. typhimurium</u> TA100	1,3-di-chloropropene purity 98	plate incorporation	10, 1, 10^{-1} μ mol/plate	$\pm$ S-9	+/+	MC	Steinberg and Mine, 1980
Reverse mutation	<u>S. typhimurium</u> TA1538, TA1535, TA100	cis-isomer	plate incorporation	20, 50, 100 μ g/plate	$\pm$ S-9	+/+	MC	Belorenzo et al., 1976, 1977
Reverse mutation	<u>S. typhimurium</u> TA100	cis-isomer 98% pure	plate incorporation	10-200 μ g/plate	$\pm$ S-9	+/+	Addition of glutathione protected against mutagenicity	Creedy et al., 1984
Reverse mutation	<u>S. typhimurium</u> TA1538, TA1537, TA1535	cis-isomer 99.97% pure	plate incorporation	0, 0.1, 0.5, 1.0 μ g/ml	$\pm$ S-9	+/+	MC	Neudecker et al., 1977
Reverse mutation	<u>S. typhimurium</u> TA1538, TA1535, TA100	trans-isomer	plate incorporation	20, 50, 100 μ g/plate	$\pm$ S-9	+/+	MC	Belorenzo et al., 1976, 1977
Reverse mutation	<u>S. typhimurium</u> TA100	trans-isomer 98% pure	plate incorporation	10-200 μ g/plate	$\pm$ S-9	+/+	Addition of glutathione protected against mutagenicity	Creedy et al., 1984
Reverse mutation	<u>S. typhimurium</u> TA1538, TA1537, TA1535	trans-isomer 97.46% pure	plate incorporation	0, 0.1, 0.5, 1.0 μ g/ml	$\pm$ S-9	+/+	MC	Neudecker et al., 1977

TABLE 5-2 (cont.)

Assay	Indicator Organism	Compound and/or Purity	Application	Concentration or Dose	Activating System	Response	Comment	Reference
Reverse mutation	<i>S. typhimurium</i> TA100	mixture of cis-, trans-isomers from several sources	plate incorporation	≤1 mg/plate	none	+	Following removal of polar impurities by chromatography, the mutagenic response was no longer observed. The impurities themselves had positive mutagenic activity.	Talcott and King, 1984
Sex-linked recessive lethal	<i>Drosophila melanogaster</i>	1,3-dichloropropene purity NR	feeding	0 and 5750 ppm	NA	+	NC	NTP, 1984
Reciprocal translocations	<i>D. melanogaster</i>	1,3-dichloropropene purity NR	injection	0 and 5750 ppm	NA	-	NC	NTP, 1984

NC - No comment

NR - not reported

NA - not applicable

5.3. TERATOGENICITY

Pertinent data regarding the teratogenicity of 1,3-dichloropropene were not located in the available literature cited in the Appendix.

5.4. OTHER REPRODUCTIVE EFFECTS

In a mouse sperm morphology assay (Osterloh et al., 1983), male mice (C57BL/6XC3H) were injected for 5 consecutive days intraperitoneally with 1,3-dichloropropene (Telone II®) in 0.25 mL corn oil at doses of 600, 300, 150, 75, 38, 19 and 10 mg/kg/day. A negative control group received only corn oil. Four mice were used per dose level. The morphology of 200 sperm/mouse was assessed 35 days after the first injection. Methyl methane-sulfonate was injected (90 mg/kg/day only) into mice as a positive control. Testicular weights, total epididymal sperm counts and percentage of abnormally-shaped sperm were averaged and compared with controls after 35 days. Methyl methanesulfonate produced a high percentage of abnormally-shaped sperm (16.4-22.9%). At the 600, 300, 150 mg/kg/day levels of 1,3-dichloropropene, all mice died before 35 days; most mice injected with 75, 38, 19 and 10 mg/kg/day survived and exhibited no significant changes in testes weight, total sperm count or percent of abnormal sperm when compared with controls. Data are presented in Table 5-3. Ten pesticides, including four known male testicular toxins and three known mutagens, were tested in this study. None of the pesticides tested positive. The authors concluded that the mouse sperm morphology assay performed by giving five daily intraperitoneal doses and examining sperm at 35 days, which tests for damage only at the spermatid stage of sperm development, was not a suitable test for male testicular toxins.

TABLE 5-3

Testicular Weights, Sperm Counts and Percent Abnormal
Sperm After Intraperitoneal Injection of
1,3-Dichloropropene^a

	Control	75 mg/kg	38 mg/kg ^b	19 mg/kg	10 mg/kg ^c
Testes weight (mg)	203±40	229±14	211±7	218±9	218±9
Total sperm count (million/ml)	25.9±8.9	32.0±3.0	32.3±4.5	29.1±6.1	25.8±0.6
Percent abnormal sperm	1.0±0.4	0.9±0.9	0.8±1.0	1.1±0.3	1.8±1.1
Methyl methanesul- fonate (positive control) percent abnormal sperm	16.4±22.9	NA	NA	NA	NA

^aSource: Osterloh et al., 1983

^bThree of four survived 35 days

^cTwo of four survived 35 days

NA = Not applicable

5.5. CHRONIC TOXICITY

In the previously reported carcinogenicity bioassay (NTP, 1984) (see Section 5.1.) rats and mice were treated by gavage with Telone II®, a commercial product containing 89% cis- and trans-1,3-dichloropropene, 2.5% 1,2-dichloropropane, 1.5% trichloropropene and 1.0% epichlorohydrin. Details regarding dosing schedule and numbers of animals were presented in Section 5.1. Toxic effects in addition to the previously reported tumor incidence (see Table 5-1) were observed.

The mean body weights of male rats treated at the 50 mg/kg dose level were ~5% lower than control after 28 weeks, while body weights of 25 mg/kg males and treated females were comparable with controls. Survival was comparable among all groups of rats, and there were no significant differences in hematologic and clinical chemistry parameters. Basal cell hyperplasia of the forestomach was observed in increased incidences in treated male and female rats, but these lesions were considered preneoplastic, since rats also had increased incidences of papillomas and carcinomas of the forestomach. The incidences of edema of the submucosa of the urinary bladder was 9/52 and 3/52, respectively, for high-dose males and females compared with 0/52 in all other groups of rats. Increased incidences of nephropathy were observed in female rats (15/52, control; 24/52, low-dose and 22/52, high-dose), but not male rats, when compared with controls.

The mean body weights of treated mice were initially lower than the vehicle controls; which was due to lack of randomization, and remained lower (~9%) throughout the study. Survival of high-dose female mice was significantly lower than control. Survival of the control males was significantly lower than the treated males. The high mortality rate was attributed to myocarditis, which was not treatment-related (see Section 5.1.). No significant differences in hematologic or clinical chemistry parameters were

observed. Dose-related increased incidences of epithelial hyperplasia of the urinary bladder were observed in male and female mice. The incidences were 0/50 for male controls, 9/50 for low-dose males and 18/50 for high-dose males; 2/50 for female controls, 15/50 for low-dose females and 19/48 for high-dose females. Increased incidences of transitional cell carcinomas of the urinary bladder were also observed in the treated groups (see Table S-1). High-dose female mice also had increased incidence of epithelial hyperplasia of the forestomach. A dose-related increased incidence of hydronephrosis occurred in female, but not male rats. The incidences were 0/50 for control females, 2/50 for low-dose females and 14/50 for high-dose females.

Torkelson and Rowe (1981) reviewed an unpublished study reported by Dow Chemical Company (1973) in which groups of rats were fed 1,3-dichloropropene by gavage at doses of 0, 1, 3, 10 or 30 mg/kg/day for 6 days/week for 13 weeks. No gross or microscopic changes were observed at any level. General condition, demeanor, survival, hematological indexes, serum exposure activity or urinalysis parameters were not affected. Relative kidney weights were increased in both sexes treated at 30 mg/kg/day. Males receiving 10 mg/kg/day also showed an increase in relative kidney weights. Additional details were not provided in the review.

As reported in abstracts of Russian studies, the effects of dichloropropene on trypsin, trypsin inhibitor, amylase and lipase activities in the serum of albino rats was investigated by Strusevich and Ekshtat (1974) and Strusevich and Sadovnik (1975). The rats were fed daily doses of 0.1, 0.5 and 2.5 mg/kg/day of dichloropropene for 6 months. Trypsin activity was increased during the entire 6 months of administration. Trypsin inhibitor activity of blood was also decreased. Blood lipase activity increased and amylase activity was unaffected.

Torkelson and Rowe (1981) reviewed inhalation studies reported by Dow Chemical Company (n.d.) in which Fischer 344 rats and CD-1 mice were exposed to vapors of Telone II® (47% cis-, 45% trans-1,3-dichloropropene, 8% related compounds). Exposure concentrations were 0, 93, 32 or 12 ppm Telone II® for 7 hours/day, 5 days/week for 13 weeks. Both sexes of rats and female mice exposed at 93 ppm failed to gain weight. High-dose male and female rats and mid-dose female rats had focal histomorphological changes of the epithelium in nasal septa and turbinates. Similar effects were observed in female but not male mice exposed at the 93 ppm level.

Parker et al. (1982) exposed groups of 28 male and 28 female CD-1 mice and Fischer 344 rats to vapors of the D-D mixture (25% cis-1,3-dichloropropene, 27% trans-1,3-dichloropropene, 29% 1,2-dichloropropane) at concentrations of 0, 5, 15 or 50 ppm for 6 hours/day, 5 days/week for 6 or 12 weeks. No clinical signs of toxicity or effects on body weight changes, hematology (HGB, HCT, RBC, WBC and differential leukocyte count), serum chemistry (BUN, GLU, ALB, GPT and ALP), urinalysis, gross pathology, histopathology, organ weights and organ-to-body weight ratios of brain, heart, liver, kidneys, testes or ovaries and adrenals were observed. Increased mean liver-to-body weight ratios of male rats were observed at the 50 ppm exposure level. Increased mean kidney-to-body weight ratios were seen at the 50 ppm exposure level in female rats. In male and female mice exposed to 50 ppm for 12 weeks, a slight to moderate diffuse hepatocytic enlargement was seen at an incidence of 12/21 for treated males, 4/18 male controls, 6/18 treated females and 1/18 female controls. No compound-related effects were seen at lower dose exposure levels.

In a preliminary inhalation study by Torkelson and Oyen (1977), rats and guinea pigs were exposed to 50 ppm (227 mg/m³) and 11 ppm (50 mg/m³) of

1,3-dichloropropene (composition not specified) for 19 seven-hour exposures in 28 days and 27 seven-hour exposures in 39 days, respectively; kidney and liver necrosis was observed. Torkelson and Oyen (1977) also exposed rats, guinea pigs, rabbits and dogs to 1,3-dichloropropene (46% cis- and 53% trans-isomer) at concentrations of 1 ppm (4.5 mg/m³) or 3 ppm (13.6 mg/m³) for 7 hours/day, 5 days/week for 6 months. The sexes and numbers of animals are given in Table 5-4. After the last exposure, a 3-month recovery period was allowed for some groups of male and female rats (Table 5-4) before analysis. In addition to the rats exposed for 7 hours/day, groups of five male rats were exposed at 3 ppm (13.6 mg/m³) for 4, 2, 1 or 0.5 hours/day, 5 days/week for 6 months. "Unexposed" controls (normal laboratory environment) and "air-exposed" controls (in sealed chambers with air only) were used. Body weight measurements and data concerning general appearance, demeanor, growth, mortality, and hematological tests (HGB, WBC, hematocrit, differential WBC) indicated no treatment-related effects. At the end of the exposure period, or at the end of the recovery period for some rats, the animals were killed and autopsies were done. Gross and histological inspection of lung, heart, liver, kidney, spleen, testes, ovaries, adrenals, pancreas, lymph nodes, intestines, stomach, thyroid, thymus, nerves, muscles, bladders and gall bladders of rats and dogs were done. The only treatment-related observations were a slight cloudy swelling of the renal tubular epithelium in male rats exposed to 3 ppm (13.6 ppm) for 4 and 7 hours/day and a higher liver-to-body weight ratio in high-dose female rats. Following the 3-month recovery period, the cloudy swelling and the increased liver weight were no longer apparent.

5.6. OTHER RELEVANT INFORMATION

LD₅₀ and LC₅₀ values for 1,3-dichloropropene are listed in Table 5-5. Torkelson and Oyen (1977) tested human volunteers for their ability to

TABLE 5-4

Average Body and Organ Weights of Animals Receiving 125-130 Repeated 7-Hour Exposures to 1 or 3 ppm 1,3-Dichloropropene

Species	Sex	Treatment	No. of Animals	Final Average Body Weight (g)	Organ Weights, g/100 g Body Weight					
					Lung	Heart	Liver	Kidney	Spleen	Testes
Rat	M	unexposed control	12	334	0.50	0.31	2.41	0.65	0.13	0.81
		air exposed control	11	350	0.50	0.32	2.46	0.64	0.15	0.78
		3 ppm 1,3-dichloropropene	9	329	0.48	0.31	2.38	0.67	0.15	0.80
		1 ppm 1,3-dichloropropene	11	326	0.57	0.32	2.33	0.66	0.16	0.85
Rat	F	unexposed control	11	202	0.65	0.37	2.62	0.77	0.17	MA
		air exposed control	11	218	0.82	0.36	2.72	0.78	0.20	MA
		3 ppm 1,3-dichloropropene	11	208	0.59	0.38	2.99 ^b	0.77	0.21	MA
		1 ppm 1,3-dichloropropene	10	209	0.70	0.39	2.82	0.65	0.21	MA
Guinea pig	M	unexposed control	8	878	0.82	0.29	3.97	0.61	0.12	0.56
		air exposed control	12	998	0.84	0.27	3.22	0.54	0.10	0.48
		3 ppm 1,3-dichloropropene	11	959	0.59	0.25	3.50	0.58	0.12	0.47
		1 ppm 1,3-dichloropropene	12	966	0.53	0.26	3.15	0.55	0.11	0.50
Guinea pig	F	unexposed control	9	724	0.65	0.33	3.57	0.64	0.16	MA
		air exposed control	11	872	0.60	0.26	3.87	0.60	0.15	MA
		3 ppm 1,3-dichloropropene	7	781	0.68	0.27	3.53	0.59	0.12	MA
		1 ppm 1,3-dichloropropene	8	858	0.65	0.26	3.52	0.58	0.12	MA
Rabbit	M	unexposed control	4	3,870	0.40	0.19	2.02	0.41	0.02	0.18
		air exposed control	3	3,810	0.35	0.19	2.40	0.44	0.03	0.16
		3 ppm 1,3-dichloropropene	2	3,460	0.36	0.18	2.30	0.50	0.03	0.16
		1 ppm 1,3-dichloropropene	1	3,140	0.46	0.22	1.70	0.52	0.04	0.26
Rabbit	F	unexposed control	2	3,950	0.38	0.17	2.08	0.49	0.03	MA
		air exposed control	3	4,350	0.32	0.17	2.28	0.37	0.05	MA
		3 ppm 1,3-dichloropropene	3	4,000	0.30	0.15	1.90	0.37	0.03	MA
		1 ppm 1,3-dichloropropene	4	3,700	0.33	0.16	1.90	0.44	0.02	MA
Dog	F	unexposed control	1	9,000	0.94	0.75	2.47	0.41	0.26	MA
		air exposed control	2	10,400	0.82	0.83	2.76	0.43	0.24	MA
		3 ppm 1,3-dichloropropene	2	8,800	0.85	0.91	2.96	0.44	0.25	MA
		1 ppm 1,3-dichloropropene	1	10,400	1.02	0.85	2.74	0.47	0.21	MA
	M	1 ppm 1,3-dichloropropene	1	12,200	0.73	0.73	2.58	0.42	0.21	0.13

TABLE 5-4 (cont.)

Species	Sex	Treatment	No. of Animals	Final Average Body Weight (g)	Organ Weights, g/100 g Body Weight					
					Lung	Heart	Liver	Kidney	Spleen	Testes
Rat (3-month recovery)	M	unexposed control	8	353	0.59	0.32	2.61	0.71	0.15	0.81
		air exposed control	2	406	0.56	0.30	2.64	0.65	0.15	0.74
		3 ppm 1,3-dichloropropene	3	363	0.43	0.30	2.48	0.67	0.14	0.68
		1 ppm 1,3-dichloropropene	9	374	0.58	0.29	2.38	0.67	0.14	0.77
Rat (3-month recovery)	F	unexposed control	10	210	0.73	0.37	2.83	0.78	0.18	MA
		air exposed control	11	233	0.59	0.37	2.74	0.59	0.16	MA
		3 ppm 1,3-dichloropropene	11	221	0.63	0.40	2.79	0.80	0.20	MA
		1 ppm 1,3-dichloropropene	10	217	0.68	0.42	2.94	0.82	0.18	MA

^aSource: Torkelson and Gyon, 1977

^bp=0.016 when compared with air exposed control

^cBecause of the small sample, p-values were not calculated. The data are within normal limits for this laboratory.

MA - Not applicable

TABLE 5-5
LD₅₀/LC₅₀ Values for Dichloropropene and Telone II

Compound	Route	Species	LD ₅₀ /LC ₅₀ Value	Comments	Reference
1,3-Dichloropropene (cis-trans mixture)	oral	rat (M)	710 mg/kg	livers and kidneys grossly affected, lung injury in survivors	Torkelson and Rowe, 1961; Dow Chemical Company, 1973
		rat (F)	470 mg/kg		
1,3-Dichloropropene	oral	rat	250-500 mg/kg	irritating to skin, eye, mucous membranes	Windholz, 1976
1,3-Dichloropropene	oral	rat	140±25 mg/kg	NC	Hine et al., 1953
		mouse	300±37 mg/kg		
	inhalation	rat	4530 mg/m ³	cumulative high acute toxicity	Hine et al., 1953
		mouse			
	dermal	rabbit	2100±260 mg/kg	single dose skin penetration	Hine et al., 1953

NC = No comment

detect the odor of 1,3-dichloropropene. At each concentration of 4.5 or 13.6 mg/m³ for 1-3 minutes, 7 of 10 individuals detected the odor, which was stronger at the higher concentration.

Torkelson and Rowe (1981) reported that direct application of two drops of 1,3-dichloropropene to the eyes of rabbits caused severe to moderate injury; vapors of 1,3-dichloropropene caused irritation and lacrimation. Application of 1,3-dichloropropene to the skin of rabbits, accompanied by the prevention of evaporation, caused necrosis and edema. Absorption through the skin occurred when 1,3-dichloropropene was applied in a propylene glycol solution or when evaporation was retarded with a cuff.

Acute studies reported by Torkelson and Oyen (1977) found that 2700 ppm (~12,000 mg/m³) 1,3-dichloropropene was extremely irritating to the respiratory tract and caused lung, nasal, liver and kidney injury in rats. Rats survived a 1-hour exposure to 1000 ppm (~4500 mg/m³), but death occurred when exposure was increased to 2 hours. Guinea pigs died following a single 7-hour exposure to 400 ppm (~1800 mg/m³); rats survived the same exposure, but severe injury and weight loss was evident. Weight loss was recovered after 8 days but lung injury was still present.

Torkelson and Oyen (1977) reported that Telone II®, in a 12.5% solution in propylene glycol, was applied under a cuff to rabbits and was undisturbed for 24 hours. Absorption occurred by this route, resulting in deaths with doses of 0.125 and 0.25 g/kg. When undiluted Telone II® was applied in the same manner to a group consisting of both sexes of rabbits, a dermal LD₅₀ value of 504 mg/kg was obtained. When applied to the eyes of six rabbits, four of the rabbits had severe conjunctival irritation and two exhibited slight to moderate corneal injury after 24 hours of observation. The effects disappeared after 8 days.

In other abstracts of Russian studies, the effects of daily oral doses of dichloropropene on rat liver function were studied by Kurysheva and Ekshtat (1975). Groups of albino rats were fed daily doses of 2.2 and 55 mg/kg bw of dichloropropene for 30 days. Excretory liver function was altered by day 30 of administration, indicated by prolonged pigment circulation in the blood, raised thymol test values and blood cholesterol levels. An increase in fructose-1-monophosphate aldolase levels was noted. Ekshtat et al. (1975) found that changes in thymol test values were pronounced only after 20 days administration of 1,3-dichloropropene using a dose of 10% of the LD₅₀.

Kurysheva et al. (1975) administered 1,3-dichloropropene at a dose level of 27.5 mg/kg/day for 15 days to rats followed by a single dose of 110 mg/kg of 1,3-dichloropropene on day 16. Decreased activity of erythrocyte Mg⁺⁺, Na⁺ and K⁺ dependant ATPase enzymes was observed after 6 hours. Increased enzyme activity was observed after 24 hours.

Findings from three case reports in humans suggest a causal relationship between exposure to 1,3-dichloropropene and hematologic malignancy (Markovitz and Crosby, 1984). Nine firemen were exposed to the chemical in the clean-up of a tank truck accident. One of these fireman, who was 32 years old at the time of exposure, developed non-Hodgkin's lymphoma and died at age 40. Another fireman, who cleaned up the same spill, was 26 years old at the time of exposure and died of histiocytic lymphoma at age 33. A farmer at age 52 was exposed by hose spray while pressure-injecting 1,3-dichloropropene into the soil. A second spray exposure occurred in the same manner a year later. Between exposures and after the second exposure he developed acute myelomonocytic leukemia, and 5 weeks after hospitalization he died of pneumonia.

Irritation to eyes and upper respiratory mucosa of humans occurs after exposure to vapors of dichloropropene (Gosselin et al., 1976). Inhalation of vapor in concentrations >1500 ppm produces headache, irritation to the mucous membranes, dizziness, nausea, vomiting, gasping, coughing, substernal pain and respiratory distress, with slight elevation of serum enzyme levels (Flessel et al., 1978; Gosselin et al., 1976). At concentrations <1500 ppm, CNS depression and moderate irritation of the respiratory system occurs (Gosselin et al., 1976). Ingestion in humans produces acute gastrointestinal distress, pulmonary congestion and edema, and CNS depression. Dermal exposure causes severe skin irritation with a marked inflammatory response.

The odor of 1,3-dichloropropene cannot be relied upon to warn against concentrations able to cause injury from prolonged repeated exposure (Torkelson and Rowe, 1981).

6. AQUATIC TOXICITY

6.1. ACUTE TOXICITY

The acute lethal effects of 1,3-dichloropropene have been determined in several freshwater fish species. Johnson and Finley (1980) reported 96-hour LC_{50} values of 1.08, 3.65 and 4.1 mg/l in walleye (Stizostedion vitreum vitreum), largemouth bass (Micropterus salmoides) and fathead minnows (Pimephales promelas), respectively. Schneider (1979) reported 24-, 48- and 96-hour LC_{50} values of 8.8, 7.2 and 5.9 mg 1,3-dichloropropene/l for rainbow trout (Salmo gairdneri). The 24- and 96-hour LC_{50} values determined in bluegill sunfish (Lepomis macrochirus) were 6.8 and 6.1 mg/l, respectively, when determined in static, capped jars (U.S. EPA, 1978; Buccafusco et al., 1981). Applegate et al. (1957) reported that exposure to 1,3-dichloropropene at 5.0 mg/l for 24 hours had no effect on larval lampreys (Petromyzon marinus).

In the marine sheepshead minnow (Cyprinodon variegatus), 24-, 48-, 72- and 96-hour LC_{50} values of 6.8-9.2, 3.3, 2.2 and 1.8 mg/l, respectively, were reported (U.S. EPA, 1978; Heitmuller et al., 1981). In these static tests no effects were observed at 1.2 mg 1,3-dichloropropene/l. LeBlanc (1984) reported a 96-hour LC_{50} value of 1.77 mg/l for sheepshead minnows.

The acute toxicity of 1,3-dichloropropene has been studied in daphnids and the mysid shrimp. In a German study (Meinck et al., 1956), the toxicity threshold for Daphnia (species not specified) was 40 mg 1,3-dichloropropene/l (duration not specified). More conservative 24- and 48-hour LC_{50} values of 7.2 and 6.2 mg/l, respectively, have been reported for Daphnia magna (U.S. EPA, 1978; LeBlanc, 1980). LeBlanc (1984) reported a 96-hour LC_{50} value for the mysid shrimp (Mysidopsis bahia) of 0.79 mg/l.

6.2. CHRONIC EFFECTS

Pertinent data regarding the effects of chronic exposure to 1,3-dichloropropene on aquatic organisms were not located in the available literature cited in the Appendix.

6.3. PLANT EFFECTS

The toxicity threshold (duration not specified) of the green alga, Shenedesmus, was reported to be 40 mg 1,3-dichloropropene/l (Meinck et al., 1956). In the freshwater alga, Selenastrum capricornutum, a 96-hour LC₅₀ value of 4.95 mg/l was reported (LeBlanc, 1984). The marine alga, Skeletonema costatum, was more sensitive, having a 96-hour LC₅₀ value of 1.00 mg 1,3-dichloropropene/l (LeBlanc, 1984).

6.4. RESIDUES

Pertinent data regarding residues of 1,3-dichloropropene in the aquatic environment or aquatic organisms were not located in the available literature cited in the Appendix.

6.5. OTHER RELEVANT INFORMATION

Additional data relevant to the aquatic toxicity of 1,3-dichloropropene were not located in the available literature cited in the Appendix.

7. EXISTING GUIDELINES AND STANDARDS

7.1. HUMAN

The ACGIH (1980, 1983) has recommended and adopted a TWA-TLV of 1 ppm (5 mg/m³) and an STEL of 10 ppm (50 mg/m³) for 1,3-dichloropropene. The values are based on the findings of Torkelson and Oyen (1977) that 1 ppm, 7 hours/day for 6 months resulted in no injury to four species and that 3 ppm resulted in slight reversible injury in one species (see Section 5.5.). Because 1,3-dichloropropene has been demonstrated to be absorbed through the skin of rabbits, a skin notation is also recommended (ACGIH, 1980). No standard has been adopted by OSHA (1981) for dichloropropene. The U.S. EPA (1983) also suggested that 1 ppm be used as the TLV. SRC (1983) calculated an ADI using data from Torkelson and Oyen (1977). The ADI value determined was 9.46 µg/day for a mixture of cis- and trans-1,3-dichloropropene based on a NOEL of 1 ppm (4.54 mg/m³) and an uncertainty factor of 1000.

7.2. AQUATIC

Guidelines and standards for the protection of aquatic organisms from the toxic effects of 1,3-dichloropropene were not located in the available literature cited in the Appendix.

8. RISK ASSESSMENT

In an NTP (1984) bioassay, increased incidences of squamous-cell papillomas and carcinomas of the forestomach and neoplastic nodules or carcinomas of the liver were observed in rats treated with Telone II® (89% 1,3-dichloropropene, 2.5% 1,2-dichloropropane, 1.5% trichloropropene and 1.0% epichlorohydrin) at gavage doses of 15 and 50 mg/kg/day, 3 days/week for 2 years (see Section 5.1. and Table 5-1). Mice similarly treated at 50 and 100 mg/kg/day had increased incidences of forestomach tumors, lung adenomas or carcinomas and transitional cell carcinomas of the urinary bladder (see Table 5-1). NTP (1984) noted that epichlorohydrin may have influenced the development of forestomach lesions. Nevertheless, NTP (1984) concluded that there was clear evidence for the carcinogenicity of Telone II® in male rats and female mice, some evidence in female rats and inadequate evidence in male mice because of high mortality in the male control group.

Weekly subcutaneous injection of cis-1,3-dichloropropene in mice at 3 mg/mouse/week resulted in significantly increased incidences of injection site fibrosarcomas (Van Duuren et al., 1979). No significant differences between treated mice and control were observed when cis-1,3-dichloropropene was tested as a tumor initiator or as a whole carcinogen on the skin of mice (Van Duuren et al., 1979).

1,3-Dichloropropene was positive for reverse mutation with and without metabolic activation in several strains of Salmonella typhimurium and for recessive lethal mutations in Drosophila melanogaster (see Table 5-2). Although Talcott and King (1984) reported that the mutagenicity of mixtures of the cis- and trans-isomers of 1,3-dichloropropene was abolished if impurities were removed by chromatography, Creedy et al. (1984), Neudecker et al. (1977) and DeLorenzo et al. (1977) found that relatively pure cis- and pure

trans-isomers were mutagenic to several strains of S. typhimurium. No teratogenicity or reproduction studies of 1,3-dichloropropene were located in the available literature cited in the Appendix.

In addition to the carcinogenic effect of long-term oral administration of Telone II® to rats and mice, NTP (1984) also reported increased incidences of edema of the submucosa of the urinary bladder in male and female rats treated at 50 mg/kg/day, 3 days/week and a dose-related increased incidence of nephropathy in females at 25 and 50 mg/kg/day, 3 days/week. Treatment-related non-neoplastic effects in mice consisted of significantly reduced survival of female mice at 100 mg/kg/day, 3 days/week and dose-related increased incidences of epithelial hyperplasia of the urinary bladder of male and female mice at 50 and 100 mg/kg/day, 3 days/week.

Torkelson and Rowe (1981) reported that relative kidney weight was increased in rats treated by gavage with 1,3-dichloropropene at 10 and 30 mg/kg/day, 6 days/week for 13 weeks.

In abstracts of Russian studies (Strusevich and Ekshtat, 1974; Strusevich and Sadovnik, 1975), effects on digestive enzymes of rats treated orally with 1,3-dichloropropene at oral doses as low as 0.1 mg/kg/day for 6 months were reported, but the reliability of such reports is questionable.

Rats treated by inhalation with Telone II® (92% dichloropropene) at 93 ppm for 7 hours/day, 5 days/week for 13 weeks failed to gain weight (Torkelson and Rowe, 1981). At 32 or 93 ppm, focal changes in the epithelium of nasal septa and turbinates were observed in rats. Female mice had similar effects at 93 ppm. No effects were observed at 12 ppm.

Liver and kidney necrosis was observed in rats exposed to 1,3-dichloropropene at vapor concentrations of 50 ppm (227 mg/m³) or 11 ppm (500 mg/m³), 7 hours/day (19 exposures in 28 days or 27 exposure in 39 days)

(Torkelson and Oyen, 1977). No adverse effects of inhalation exposure were observed in guinea pigs, rabbits or dogs at 1 ppm (4.5 mg/m³) or 3 ppm (13.6 mg/m³), 7 hours/day, 5 days/week for 6 months. (Torkelson and Oyen, 1977). Rats exposed at 3 ppm for 4 or 7 hours/day, 5 days/week for 6 months had cloudy swelling of the renal tubule epithelium and increased relative liver weight, but these effects were not apparent in rats similarly treated and observed for an additional 3 months.

Parker et al. (1982) found no effects in rats and mice exposed by inhalation to the D-D formulation (52% 1,3-dichloropropene, 29% 1,2-dichloropropane) at ≤ 15 ppm, 6 hours/day, 5 days/week for 12 weeks. At 50 ppm, relative liver and kidney weights were increased in rats, and increased incidences of hepatocellular hypertrophy were observed in mice.

Although a NOAEL for 1,3-dichloropropene cannot be defined based upon the available oral data, a LOAEL of 3 ppm (13.6 mg/m³), 4 hours/day, 5 days/week in rats and a NOEL of 1 ppm (4.5 mg/m³), 7 hours/day, 5 days/week in rats can be defined from the inhalation study of Torkelson and Oyen (1977). The resultant ADI would be the same as that previously derived by SRC (1983) of 9.46 μ g/day (see Section 7.1.).

Because of the demonstrated carcinogenicity of Telone II® (92% 1,3-dichloropropene) in animals, however, it is appropriate to derive a q_1^* for 1,3-dichloropropene. Data used to calculate q_1^* values are presented in Tables 8-1 to 8-10. Although NTP (1984) noted that epichlorohydrin, as a 1% impurity of Telone II®, may have contributed to the development of forestomach tumors, q_1^* determinations were made using these data for the sake of comparison. Data on tumor incidence in male mice were not used because the high mortality of control male mice confounded the interpretation of the results (see Section 5.1.).

TABLE 8-1

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (t_e) = 728 daysLength of experiment (L_e) = 728 daysLifespan of animal (L) = 728 days

Tumor site and type: forestomach, squamous-cell papilloma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	1/52
25x3/7	10.7	1/52
50x3/7	21.4	9/52

Unadjusted q_1^* from study = 6.9302×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 3.8138×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-2

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/female

Body weight: 0.31 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (L_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: forestomach, squamous-cell papilloma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	0/52
25x3/7	10.7	2/52
50x3/7	21.4	3/52

Unadjusted q_1^* from study = 5.9232×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 3.6069×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-3

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (L_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: forestomach, squamous-cell carcinoma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	0/52
25x3/7	10.7	0/52
50/3/7	21.4	4/52

Unadjusted q_1^* from study = 4.0678×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 2.2386×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-4

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (L_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: liver, neoplastic nodules

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	1/52
25x3/7	10.7	6/52
50x3/7	21.4	7/52

Unadjusted q_1^* from study = 1.162×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 6.3947×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-5

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: mice/B6C3F1/female

Body weight: 0.035 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (t_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: forestomach, squamous cell papilloma or carcinoma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	0/50
50x3/7	21.4	1/50
100x3/7	42.8	4/50

Unadjusted q_1^* from study = 2.9294×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 3.6908×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-6

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: mice/B6C3F1/female

Body weight: 0.035 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (L_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: urinary bladder, transitional cell carcinoma

Route, vehicle: oral (gavage), corn oil

Experimental Doses or Exposures (mg/kg/day)	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	0/50
50x3/7	21.4	8/50
100x3/7	42.8	21/48

Unadjusted q_1^* from study = 1.3836×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 1.7432×10^{-1} (mg/kg/day) $^{-1}$

TABLE 8-7

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: mice/B6C3F1/female

Body weight: 0.035 kg (measured)

Length of exposure (t_e) = 104 weeksLength of experiment (L_e) = 104 weeksLifespan of animal (L) = 104 weeks

Tumor site and type: lung, alveolar/bronchiolar adenomas

Route, vehicle: oral, corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	0/50
50x3/7	21.4	3/50
100x3/7	42.8	8/50

Unadjusted q_1^* from study = 5.6723×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 7.1466×10^{-2} (mg/kg/day) $^{-1}$

TABLE 8-8

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (1e) = 728 days

Length of experiment (Le) = 728 days

Lifespan of animal (L) = 728 days

Tumor site and type: forestomach, squamous-cell papilloma and carcinoma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	1/52
25x3/7	10.7	1/52
50x3/7	21.4	13/52

Unadjusted q_1^* from study = $6.3857 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ Human q_1^* = $3.5142 \times 10^{-1} \text{ (mg/kg/day)}^{-1}$

TABLE 8-9

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (t_e) = 728 daysLength of experiment (L_e) = 728 daysLifespan of animal (L) = 728 days

Tumor site and type: liver, neoplastic nodules and carcinoma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	1/52
25x3/7	10.7	6/52
50x3/7	21.4	8/52

Unadjusted q_1^* from study = 1.2558×10^{-1} (mg/kg/day) $^{-1}$ Human q_1^* = 6.9109×10^{-1} (mg/kg/day) $^{-1}$

TABLE 8-10

Cancer Data Sheet for Derivation of q_1^*

Compound: Telone II®

Reference: NTP, 1984

Species, Strain, Sex: rat/F344/male

Body weight: 0.42 kg (measured)

Length of exposure (t_e) = 728 daysLength of experiment (L_e) = 728 daysLifespan of animal (L) = 728 days

Tumor site and type: lung, alveolar/bronchiolar adenomas and carcinoma

Route, vehicle: oral (gavage) corn oil

Experimental Doses or Exposures (mg/kg/day)*	Transformed Dose (mg/kg/day)	Incidence No. Responding/No. Tested or Examined
0	0	2/50
25x3/7	10.7	4/50
50x3/7	21.4	8/50

Unadjusted q_1^* from study = 5.2232×10^{-2} (mg/kg/day) $^{-1}$ Human q_1^* = 6.5809×10^{-1} (mg/kg/day) $^{-1}$

The values for q_1^* were calculated using the linearized multistage model developed by Kenneth Crump and adopted by the U.S. EPA (Federal Register, 1980). The conversion factor used to adjust for species-to-species extrapolation was the cube root of the ratio of the average body weight of a man (assumed to be 70 kg) to the body weight of the experimental animal (see Tables 8-1 to 8-10). The highest value for the q_1^* for humans is $1.74 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$ and was obtained from the dose-response data for increased incidences of transitional cell carcinomas of the urinary bladder of female mice (see Table 8-6). The q_1^* values obtained from the data on forestomach tumors are 3-8 times lower than the recommended q_1^* of $1.74 \times 10^{-2} \text{ (mg/kg/day)}^{-1}$.

Statements concerning available literature in this document refer to published quotable sources and are in no way meant to imply that classified data, which this document could not address, are not in existence. These data, which are considered Confidential Business Information (CBI), are available in summary form as a CBI Appendix that can be accessed by individuals with appropriate clearance.

The CBI Appendix to this document reviews other animal studies, none of which warrant a change in the above risk assessment.

9. REPORTABLE QUANTITIES

9.1. REPORTABLE QUANTITY (RQ) RANKING BASED ON CHRONIC TOXICITY

The available data on the effects of long-term administration of 1,3-dichloropropene in animals were discussed in detail in Section 5.5. In a carcinogenicity bioassay of Telone II® (89% 1,3-dichloropropene, 2.5% 1,2-dichloropropane, 1.5% trichloropropene and 1% epichlorohydrin), rats were treated by gavage at 25 and 50 mg/kg/day and mice were treated by gavage at 50 and 100 mg/kg/day, 3 days/week for 2 years. Non-neoplastic effects consisted of increased incidences of edema of the submucosa of the urinary bladder in both sexes of high-dose rats, increased incidences of nephropathy in low- and high-dose female rats, reduced survival of high-dose mice and increased incidences of epithelial hyperplasia of the urinary bladder of high-dose male and female mice.

In a study by Dow Chemical Company (1973), no effects in rats were observed at gavage doses of 1,3-dichloropropene ≤ 3 mg/kg/day, 6 days/week for 13 weeks. Relative kidney weights were increased at ≥ 10 mg/kg/day.

In abstracts of Russian studies (Strusevich and Ekshtat, 1974; Strusevich and Sadovnik, 1974), effects on digestive enzymes of rats were reported at oral doses of ≥ 0.1 mg/kg/day for 6 months. These data cannot be used for the derivation of the RQ because such reports are generally unreliable.

Torkelson and Rowe (1981) reported that rats exposed by inhalation to Telone II® (92% 1,3-dichloropropene) at 93 ppm (422 mg/m³), 7 hours/day, 5 days/week for 13 weeks failed to gain weight. Focal changes in the epithelium of nasal septa and turbinates were observed in rats exposed similarly at 32 or 93 ppm (145 or 422 mg/m³). Female mice were reported to have similar effects at 93 ppm (422 mg/m³). At inhalation exposures of

1,3-dichloropropene of 50 ppm (227 mg/m³) or 11 ppm (50 mg/m³), 7 hours/day (19 exposures in 28 days or 27 exposures in 39 days, respectively). Liver and kidney necrosis occurred in rats (Torkelson and Oyen, 1977). The only effects observed among rats, guinea pigs, dogs or rabbits exposed by inhalation to 1,3-dichloropropene, $\leq$ 7 hours/day, 5 days/week for 6 months, were increased relative liver weight of female rats (13.6 mg/m³, 7 hours/day) and cloudy swelling of the renal tubule epithelium of male rats (13.6 mg/m³, 4 or 7 hours/day) (Torkelson and Oyen, 1977). These effects appeared to be reversible, since rats similarly exposed and observed for an additional 3 months did not have observable effects.

Parker et al. (1982) found that inhalation exposure to 50 ppm of the D-D formulation (52% 1,3-dichloropropene, 29% 1,2-dichloropropane) resulted in increased relative liver and kidney weights of rats and hepatocellular hypertrophy in mice. This study cannot be used for the derivation of the RQ for 1,3-dichloropropene because of the high concentration of 1,2-dichloropropane in the D-D mixture.

The data used for the calculation of CSs are summarized in Table 9-1. To calculate the MED from oral exposure data, the animal doses were expanded to TWA doses, which were multiplied by the cube root of the ratio of the animal body weight to the weight of man (70 kg) and by 70 kg. For the NTP (1984) study, the body weights were estimated to be 0.31 kg for female rats and 0.035 kg for female mice [no MEDs were based on male rat or male mouse data in the NTP (1984) study]. For the Dow Chemical Company (1973) study, the weight of the rat was assumed to be 0.35 kg. For inhalation exposures, human MEDs were calculated from the exposure concentration, expanded over a 24-hour day and a 7-day week, and multiplied by appropriate animal breathing rate and body weight correction factors and 70 (assumed human body weight).

TABLE 9-1

Composite Scores for Toxicity of 1,3-Dichloropropene

Route	Species	Animal Dose/Exposure	Chronic Human HED (mg/day)	RV ₆	Effects	RV ₆	CS	SD	Reference
Oral	rat	25 mg/kg/day, 3 days/week, 2 years (TD ₀₁ -10.7 mg/kg/day)	123	2.4	Increased incidence of nephropathy	6	14.4	1000	NIH, 1984
Oral	rat	10 mg/kg/day, 6 days/week for 13 weeks (TD ₀₁ -5.6 mg/kg/day)	10.3 ^a	4.0	Increased kidney weight	4	16	1000	Dow Chemical Company, 1973
Oral	mouse	100 mg/kg/day, 3 days/week, 2 years (TD ₀₁ -12.9 mg/kg/day)	220.8	1.96	Reduced survival, hyperplasia of urinary bladder epithelium	10	19.6	1000	NIH, 1984
Inhalation	rat	145 mg/m ³ , 7 hours/day, 5 days/week, 13 weeks	25.1 ^b	3.4	Focal changes in epithelium of nasal septa and turbinate	4	13.6	1000	Torkelson and Snow, 1981
Inhalation	rat	50 mg/m ³ , 7 hours/day (27 exposures in 35 days)	8.48	4.1	Liver and kidney necrosis	6	24.6	100	Torkelson and Snow, 1977
Inhalation	rat	13.6 mg/m ³ , 4 hours/day, 5 days/week, 6 months	2.7 ^b	4.8	Reversible cloudy swelling of renal tubule epithelium	5	24	100	Torkelson and Snow, 1977

^aThe animal dose/exposure was divided by an uncertainty factor of 10 to approximate chronic exposure.

^bThe animal exposure was divided by an uncertainty factor of 5 to approximate chronic exposure.

For subchronic exposures, the dose or exposure was divided by an uncertainty factor of 10 to approximate chronic exposure. For the 6-month study of Torkelson and Oyen (1977), an uncertainty factor of 5 was used.

As seen from Table 9-1, the highest CS (24) was obtained from the short-term study of Torkelson and Oyen (1977) in which rats exposed by inhalation to 50 mg/m³ 1,3-dichloropropene, 7 hours/day, 27 exposures in 39 days, had liver and kidney necrosis. The CS of 24 corresponds to an RQ of 100. An RQ of 100 is also obtained from the CS of 23.5, based on reversible cloudy swelling of the renal tubule epithelium in rats exposed by inhalation to 13.6 mg/m³, 4 hours/day, 5 days/week for 6 months (Torkelson and Oyen, 1977). Since the CSs are virtually identical and greater detail was presented in the account of the 6-month experiment, the CS and RQ derived from the 6-month data are recommended for 1,3-dichloropropene (Table 9-2). These data (Table 9-2) are the same as those used in the previous derivation of the RQ for 1,3-dichloropropene (U.S. EPA, 1983).

9.2. WEIGHT OF EVIDENCE AND POTENCY FACTOR ($F=1/ED_{10}$) FOR CARCINOGENICITY

The NTP (1984) draft report gives clear evidence of carcinogenicity in rats and mice after oral exposure to Telone II® (1,3-dichloropropene) (see Table 5-1). Squamous-cell papillomas and carcinomas of the forestomach and increased incidence of neoplastic nodules of the liver were observed in male F344 rats. Squamous-cell papillomas were observed in female F344 rats. In female B6C3F1 mice, increased incidences of transitional-cell carcinomas of the urinary bladder were seen as well as alveolar/bronchiolar adenomas of the lung and squamous-cell papillomas or carcinomas of the forestomach. Results in male B6C3F1 mice were not clear because of high mortality in the control group. Dose-related increased incidences of transitional-cell carcinomas of the urinary bladder, squamous-cell papillomas of the forestomach

TABLE 9-2

1,3-Dichloropropene

Minimum Effective Dose (MED) and Reportable Quantity (RQ)

Route:	Inhalation
Dose*:	2.69 mg/day
Effect:	Slight cloudy swelling of renal tubular epithelium
Reference:	Torkelson and Oyen, 1977
RV_d:	4.8
RV_e:	5
Composite Score:	24
RQ:	100

*Equivalent human dose

and alveolar/bronchiolar adenomas and carcinomas of the lung, however, were observed. Van Duuren et al. (1979) also observed sarcomas in Swiss mice injected with 1,3-dichloropropene. Markovitz and Crosby (1984) found some evidence for a causal relationship between exposure to 1,3-dichloropropene and the development of hematologic malignancy (see Section 5.6.).

1,3-Dichloropropene (and Telone II®) is given an IARC (1982) group 2B rating, as a chemical or group of chemicals that is probably carcinogenic for humans. It is placed in group B because evidence in humans is only suggestive.

Data used to calculate the potency factor (F or $1/ED_{10}$) is summarized in Table 9-3. A potency factor was derived using the linearized multistage model developed by Kenneth Crump and adopted by the U.S. EPA (Federal Register, 1980). The unadjusted $1/ED_{10}$ obtained from the animal data was corrected for interspecies extrapolation by multiplying the cube root of the weight of a man (70 kg) by the weight of the animal. In considering dose-response data for derivation of the F factor, the data for increased incidences of forestomach lesions were not used because NTP (1984) noted that the Telone II® used in the study contained 1% epichlorohydrin, which may have contributed to the development of the forestomach lesions. Values for the F factor were calculated for the incidence of urinary bladder transitional cell carcinoma in female mice (8.04×10^{-1} , see Table 9-3), for lung adenomas in female mice (4.08×10^{-1} , data not included in Table 9-3, see Table 5-1 for incidences) and for neoplastic nodules of the liver in male rats (3.57×10^{-1} , data not included in Table 9-3, see Table 5-1 for incidences). The highest F factor (8.04×10^{-1}) was obtained from the dose-response data for the incidence of transitional-cell carcinoma of the

TABLE 9-3

Derivation of Potency Factor (F)
Agent: 1,3-Dichloropropene (Telone II®)

Reference:	NTP, 1984		
Exposure route:	oral, gavage		
Species:	mouse		
Strain:	B6C3F1		
Sex:	female		
Vehicle or physical state:	corn oil		
Body weight ^a :	0.035 kg ^b		
Duration of treatment:	104 weeks		
Duration of study:	104 weeks		
Lifespan of animal:	104 weeks ^a		
Target organ:	urinary bladder		
Tumor type:	transitional cell carcinoma		
Experimental doses/exposure (mg/kg/day, 3 days/week):	0	50	100
Transformed doses (mg/kg/day):	0	21.4	42.8
Tumor incidence:	0/50	8/50	21/48
Unadjusted 1/ED ₁₀ (F Factor):	6.385x10 ⁻²		
1/ED ₁₀ (F factor):	8.04x10 ⁻¹		

^aestimated^breported

urinary bladder in female mice. Since the F factor is <1 , 1,3-dichloropropene is placed in Potency Group 4, and since the chemical is in group 28 according to the IARC classification, 1,3-dichloropropene has a Low Hazard Ranking according to the Hazard Ranking Scheme for Reportable Quantities under CERCLA.

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APPENDIX
LITERATURE SEARCHED

This profile is based on data identified by computerized literature searches of the following:

CA SEARCH (Files 308, 309, 310, 311, 320)
TOXLINE
RTECS
OHM TADS
STORET
SRC Environmental Fate Data Bases
SAMSS
AQUIRE
TSCAPP

These searches were conducted in November, 1984. In addition, hand searches were made of Chemical Abstracts (Collective Indices 6 and 7), and the following secondary sources were reviewed:

ACGIH (American Conference of Governmental Industrial Hygienists). 1980. Documentation of the Threshold Limit Values, 4th ed. (Includes Supplemental Documentation, 1981, 1982, 1983). Cincinnati, OH. 486 p.

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Clayton, G.D. and F.E. Clayton, Ed. 1981. Patty's Industrial Hygiene and Toxicology, 3rd rev. ed., Vol. 2A. John Wiley and Sons, NY. p. 2878.

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IARC (International Agency for Research on Cancer). IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. WHO, IARC, Lyons, France.

ITII (International Technology Information Institute). 1982. Toxic and Hazardous Industrial Chemicals Safety Manual for Handling and Disposal with Toxicity and Hazard Data. ITII, Tokyo, Japan. 700 p.

NTP (National Toxicology Program). 1984. Toxicology Research and Testing Program. Chemicals on Standard Protocol. Management Status.

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USITC (United States International Trade Commission). 1983. Synthetic Organic Chemicals. U.S. Production and Sales, 1982, USITC Publ. 1422. Washington, DC.

Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals, 2nd ed. Van Nostrand Reinhold Co., NY.

Worthing, C.R. and S.B. Walker, Ed. 1983. The Pesticide Manual. British Crop Protection Council. 695 p.

In addition, approximately 30 compendia of aquatic toxicity data were reviewed, including the following:

Battelle's Columbus Laboratories. 1971. Water Quality Criteria Data Book, Vol. 3. Effects of Chemicals on Aquatic Life. Selected Data from the Literature through 1968. Prepared for the U.S. EPA under Contract No. 68-01-0007. Washington, DC.

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